REMARKS

Claims 27-39 and 41-60 are pending in this application. An appendix of the currently pending claims is provided for the Examiner's convenience.

Rejections based on Kashiwase Reference

In paragraph four of the Office Action, claims 27-28, 30-32, 34-39, 41-43, 48-49, 51-54, 57 and 60 were rejected under 35 U.S.C. §103(a) as being unpatentable over Kashiwase et al. (U.S. Patent No. 5,378,317) in view of Sehested et al. (J.Phys.Chem.). In paragraph five of the Office Action, claims 33, 47 and 55 were rejected under 35 U.S.C. §103(a) as being unpatentable over Kashiwase et al. (U.S. Patent No. 5,378,317) in view of Sehested et al. (J.Phys.Chem.) and further in view of Kern (Hand Book of Semiconductor wafer cleaning technology). In paragraph six of the Office Action, claims 29, 44-46, 50 and 58-59 were rejected under 35 U.S.C. §103(a) as being unpatentable over Kashiwase et al. (U.S. Patent No. 5,378,317) in view of Sehested et al. (J.Phys.Chem.) and Kern (Hand Book of Semiconductor wafer cleaning technology), and further in view of Stanford et al. (U.S. Patent No. 5,244,000).

The Kashiwase reference is directed to "a method for removing organic film, and in particular to a method of removing a photo resist film". Col. 1, lines 9-11. The Kashiwase reference, in its background section, reviews the background art in removing resist film. Kashiwase first reviews a "normal" two step method of: (1) using a mixture solution of sulfuric acid and hydrogen peroxide; and (2) using ultra pure water to clean the residue, as stated in the following:

> When the photo resist film is removed using a mixed solution of sulfuric acid and hydrogen peroxide, a chemical solution such as sulfuric acid attached on the film is removed after the removal of the photo resist film, and ultra pure water is used for removing and cleaning the residue.

Col. 1, lines 55-60. Kashiwase states that, because hydrogen peroxide is used, this method has a drawback "[t]o maintain the oxidizing ability of this mxied [sic] solution, it is necessary to replenish a new solution by removing sulfuric acid and hydrogen peroxide, which have been consumed by oxidizing decomposition of the photo resist film and have decreased concentration." Col. 2, lines 10-15.

Kashiwase then reviews a method proposed by Japanese Patent Publication No. 52-12063 wherein the chemical solution in the first step of the process is modified. Instead of using hydrogen peroxide with the sulfuric acid, ozone is substituted for the hydrogen peroxide so that the chemical solution applied is a combination of sulfuric acid and ozone. See col. 2, lines 16-21. Kashiwase states that, with this method, the drawback of using hydrogen peroxide (which requires replenishing the solution) is overcome by using ozone; however, Kashiwase finds other drawbacks in using ozone in combination with a processing solution, such as sulfuric acid, and concludes the following:

> Thus, the introduction of ozone into the processing solution does not necessarily result in effective use of ozone. Accordingly, even when ozone is introduced into sulfuric acid, the oxidizing ability of ozone is not effectively utilized.

Col. 2, lines 44-46. Kashiwase thus concludes that introduction of ozone into the chemical solution is not recommended.

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Finally, Kashiwase states that in removing photo resist film, the final step must be an ultra pure water rinse, in order to remove the chemical solution from the previous cleaning step, as discussed in the following:

> Further, it is necessary to provide a process to remove the chemical solution by completely rinsing with ultra pure water after the processing with the chemical solution.

Col. 2, lines 52-55.

Faced with these problems, Kashiwase solves them by providing a two-step solution for removing organic contaminants: (1) "immersing [the substrate] in a mixed solution of sulfuric acid and hydrogen peroxide by a normal wet method for removing photo resist film, or a dry processing using oxygen plasma"; and (2) rins[ing] by a solution containing ozone in a dissolved state or in a bubbling state (a solution containing ozone), prepared by introducing ozone into ultra pure water." Col. 4, lines 23-26, 30-33. This is shown, for example, in the following:

> After the processing by ozone has been completed, the substrate 52 is housed in a cassette 62 as shown in FIG. 4 (B) just as in the case of the substrate after the completion of processing by chemical solution. The cassette 62 is then immersed in an ozone processing tank 63, and the residue is removed by water containing ozone.

Col. 6, lines 25-31.

To establish a *prima facie* case of obviousness, there must be some suggestion or motivation to modify the reference or combine reference teachings. *See* MPEP §2143. The suggestion or motivation to combine the references must be found either explicitly or implicitly in the references themselves. The mere fact that references can be combined or modified is not sufficient to establish a *prima facie* case of obviousness; rather, the suggestion must be present. Further, if one of the references teaches away from the combination, obviousness is not proper.

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In the present case, each of the independent claims, as currently written, recite contacting the substrate with a fluid or a liquid comprising water, ozone and an additive acting as a scavenger. See claims 27, 49, 51 and 60. In making its *prima facie* case of obviousness, the Office Action states that "Kashiwase et al remain silent about the introduction of an additive such as acetic acid acts as OH radical scavenger." The Office Action further looks to the teaching of Sehested for the introduction of the additive acting as a scavenger. However, Applicants respectfully disagree that the Kashiwase reference is silent about the introduction of an additive. In fact, the Kashiwase reference actually teaches away from the adding of chemicals, such as an additive, with ozone. This is supported in two separate ways. First, Kashiwase teaches that the use of ozone in combination with chemicals, such as sulphuric acid, is not recommended. In the background section of the Kashiwase reference, it reviews Japanese Patent Publication No. 52-12063 and states that "ozone is not effectively utilized." To more effectively utilize ozone, Kashiwase teaches that the ozone should not be used with any other chemicals (and should be used in combination with ultra pure water). Thus, the combination of the Kashiwase reference with the Sehested reference would result in the use of ozone in combination with a chemical, directly contrary to the Kashiwase teaching. Second, Kashiwase teaches that ozone should be used in combination with the ultra pure water rinse. Kashiwase recognizes the "normal" two-step cleaning process of photo resist film, namely a chemical solution step followed by an ultra pure water rinse step. Kashiwase states that, instead of modifying the first step in the process (the chemical solution step), the second step should be modified (the ultra pure water rinse step). The reasoning is that the ultra pure water step is still

necessary to remove the residue of the chemical solution. Adding ozone to the ultra pure water does not interfere with the rinsing of the chemical solution from the substrate. However, adding chemicals to the ultra pure water, as the Office Action suggests in the combination with Sehested, would defeat the purpose of Kashiwase's use of the ultra pure water rinse, namely rinsing away the chemicals. "Where a proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification." MPEP §2143.01, p. 2100-124. Thus, the Kashiwase reference should not be combined with the Sehested reference (or the Kern or Stanford references) to render the pending claims obvious.

CONCLUSION

If for any reason, the application is not considered to be in condition for allowance on the next Office Action and an interview would be helpful to resolve any remaining issues, the Examiner is requested to contact the undersigned attorney at (312) 913-0001.

Respectfully submitted,

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APPENDIX OF CURRENTLY PENDING CLAIMS

27. A method for removing organic contaminants from a substrate, the organic contaminants resulting from a previous lithographic step, the method comprising the steps of:

contacting at least one side of said substrate with a liquid comprising water, ozone and an additive acting as a scavenger, wherein the proportion of said additive in said liquid is less than 1% molar weight of said liquid; and

maintaining said liquid at a temperature less than the boiling point of said liquid.

28. A method as recited in claim 27, wherein said temperature is lower than 100°C.

29. A method as recited in claim 27, wherein said liquid is sprayed over at least one side of said substrate.

30. A method as recited in claim 27, wherein said temperature is between 16°C and 99°C.

31. A method according as recited in claim 30, wherein the temperature of said liquid is between 20°C and 90°C.

32. A method according as recited in claim 31, wherein the temperature of said liquid is between 60°C and 80°C.

33. A method as recited in claim 27, wherein said liquid is subjected to megasone agitation.

34. A method as recited in claim 27, wherein the ozone is bubbled through the liquid.

35. A method as recited in claim 27, wherein the organic contamination is a confined layer covering at least part of said substrate.

36. A method as recited in claim 35, wherein said confined layer has a thickness in a range of submonolayer coverage and 1 μm.

37. A method as recited in claim 27, wherein said additive is acting as OH radical scavenger.

38. A method as recited in claim 27, said additive is selected from the group consisting of a carboxylic acid, a phosphonic acid, and salts thereof.

39. A method as recited in claim 38, wherein said additive is acetic acid.

41. A method according to claim 27, wherein the proportion of said additive in said liquid is less than .1% molar weight of said liquid.

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42. A method according to claim 41, wherein the proportion of said additive in said liquid is less than 0.1% molar weight of said liquid.

43. A method as recited in claim 27, wherein the ozone includes ozone bubbles and wherein the ozone bubbles are contacting said organic contaminants.

44. A method as recited in claim 27, further comprising the step of rinsing said substrate with a solution.

45. A method as recited in claim 44, wherein said solution comprises de-ionised water.

46. A method as recited in claim 45, wherein said solution further comprises at least one solution selected from the group consisting of HCl, HF, HNO_3, CO_2 and O_3.

47. A method as recited in claim 44, wherein said solution is subjected to megasone agitation.

48. A method as recited in claim 27, wherein said substrate is a silicon wafer.

49. A method for removing organic contaminants from a substrate comprising the steps of:

holding said substrate in tank; and

filling said tank with a fluid comprising water, ozone and an additive acting as a scavenger, and wherein the proportion of said additive in said fluid is less than 1% molar weight of said fluid.

50. A method as recited in claim 27, wherein at least one side of said substrate is in contact with a mist of said liquid.

51. A method for removing organic contaminants from a substrate, the organic contaminants resulting from a previous lithographic step, the method comprising the steps of:

contacting at least one side of said substrate with a liquid comprising water, ozone and an additive acting as a scavenger, wherein said liquid is comprised substantially of water; and

maintaining said liquid at a temperature less than the boiling point of said liquid.

52. A method as recited in claim 51, wherein the proportion of said additive in said liquid is less than 1% molar weight of said liquid.

53. A method according to claim 52, wherein the proportion of said additive in said liquid is less than 0.1% molar weight of said liquid.

54. A method as recited in claim 51, wherein the temperature of said liquid is between 60°C and 80°C.

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55. A method as recited in claim 51, wherein said liquid is subjected to megasone agitation.

56. A method as recited in claim 51, wherein the ozone is bubbled through the liquid.

57. A method as recited in claim 51, wherein said additive is acting as OH radical scavenger.

58. A method as recited in claim 51, further comprising the step of rinsing said substrate with a solution.

59. A method as recited in claim 58, wherein said solution comprises de-ionised water.

60. A method for removing organic contaminants from a substrate, the organic contaminants resulting from a previous lithographic step, the method comprising the steps of:

holding said substrate in a tank; and

filling said tank with a fluid comprising water, ozone and an additive acting as a scavenger, and wherein the fluid is comprised substantially of water.

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